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SEDIMENT PRODUCTION RATING, YAKIMA BASIN, WASHINGTON

Public Health Service
Portland, Oregon

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WORKING PAPER NO. 11

Columbia River Basin Project
For Water Supply and Water Quality Management

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Region IX

Division of Water Supply and Pollution Control
570 Pittock Block
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I

This working paper contains preliminary data and information primarily intended for internal use by the Columbia River Basin Project staff and cooperating agencies. The material presented in this paper has not been fully evaluated and should not be considered as final.

SEDIMENT PRODUCTION RATING
YAKIMA BASIN
WASHINGTON

INTRODUCTION

After finishing the field work on the Umpqua and Willamette Basins west of the Cascades in Oregon, the survey was begun on the Yakima Basin east of the mountains in Washington. Though climate and geology and soils and land use are quite different in the Yakima, the sediment production ratings based on field inspection of watershed lands and streams should correlate well with those of the basins done earlier. No sediment sampling or reservoir sedimentation data were available to guide the survey in this basin.

SUMMARY AND CONCLUSIONS

Overall, the Yakima Basin is rated "moderate" as a sediment producer.

The several reservoirs in the mountain areas trap much of the sediment coming from lands given a "high" sediment production rating at the upper elevations. Sediment movement across flat valley lands below "high" rated slopes and ridges in the lower watershed appears quite limited.

Along the middle and lower reaches of the Yakima River, the bulk of the sediment load most probably comes from bankcutting and reworking of channel deposits at times of high flow, and from irrigation return flows during the summer season.

Some special sediment sources such as the heavily grazed scab ridges at middle elevations and the Swauk Creek dredge-mining spoil deposits are worth mention as particular problem areas; but generally the sediment sources are widely distributed and attributable to a number of different causes in each component watershed.

Only the Satus Creek watershed was given a uniformly "high" rating; a rating applied because of apparent extensive heavy grazing use on areas of unstable geology and rough topography.

DESCRIPTION OF BASIN

The Yakima Basin is roughly triangular in shape, with the base of the triangle against the Cascade mountains. The Yakima River drains east from the southern Cascades in Washington to its confluence with the Columbia near Pasco. Major tributaries include, from north to south, Wilson Creek, Swauk Creek, Teanaway River, CleElum River, Taneum Creek, Manastash Creek, Wenas Creek, Naches River, Ahtanum Creek, Toppenish Creek, and Satus Creek. Total area of the basin is about 5,970 square miles. (1)

Elevations range from about 8,000 feet on some of the peaks of the Cascades along the western boundary of the basin down to 320 feet at the confluence of the Yakima and the Columbia. The northern boundary reaches elevations of 5,000 to 7,000 feet in the Wenatchee Mountains, and the southern from 2,000 feet in the Horse Heaven Hills to 3,500 feet in the Simcoe Mountains.

Several parallel ridges trending more or less east-west separate the major tributary watersheds and divide the basin. Elevations on these ridges range from 2,500 to 4,000 feet. The upper valley around Ellensburg at an elevation of 1,500 feet is separated by a 20-mile gorge from the middle valley around Yakima at an elevation of about 1,000 feet. Just below Yakima, the river spills through a short gap to the lower valley extending from Wapato to Prosser.

Channel gradients are steep in the mountain sections and in the gorges separating the valley parts. The relief is rugged, and characterized by long steep slopes. Ridges generally are flat-topped.

Predominant geologic formations are the Oligocene and Miocene volcanics. Only a few small areas of older and nonvolcanic rocks occur in the headwaters. Valleys are filled with recent alluvium, plus eolian deposits around Ellensburg and Yakima, and glacial lake deposits in the lower valley. Soils include the light silty wind-deposited soils, light sandy alluvial soils, and heavy residual soils developed from the volcanic and older nonvolcanic formations. The lighter soils are readily eroded by wind when denuded, and the heavier soils by water.

Climate of the basin is of the winter wet and summer dry type, strongly modified by the Pacific Ocean one hundred and fifty miles to the west. In the extreme western mountain fringe of the basin, the average annual precipitation reaches 100 inches. The average falls off rapidly toward the center and lower end of the basin, where it is less than eight inches at some stations. Average temperature is at or below freezing a couple of months in the winter, even in the lowest and warmest parts of the basin. Strong winds are common in spring and fall.

Much of the precipitation, particularly in the mountainous headwaters, is received as snow. The streamflow regime is controlled primarily by the spring snowmelt. Flow in the Yakima River averages about 3,920[1/] cfs for an annual yield of 2,837,000 acre-feet. Peak flows

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1/ U.S.G.S. records for Kiona gage and Corps of Engineers report.

in excess of 65,000[1/] cfs have been recorded, and a minimum flow well under 200[1/] cfs. Average maximum is 6,260[1/] cfs, and average minimum is 1,060[1/] cfs. While high flows from rainstorms can occur in November and December, most high flows occur in April and May and June from snowmelt. Spring and summer cloudbursts from limited area convectional storms occur infrequently but have resulted in flood flows and excessive sediment movement in some streams.

Headwater areas of the basin have a forest cover. At the upper elevations, this is a mixed conifer forest, quite dense. With decreasing elevation, the forest changes to ponderosa pine, more open in character. Below the forest is sagebrush and grassland. Valleys are cultivated, with fruit orchards, pastures, hayfields, and a variety of truck and grain crops. Basin cropland totals about 1,750,000 acres, of which about 450,000 acres are irrigated and the rest dry farmed or pastured. Forest land equals about 1,620,000 acres, and rocky brush and grass about 450,000 acres. Much of the so-called pasture might be added to this latter category.

Forest occupies the areas of high precipitation that have water surpluses to produce streamflow. Though average water yield equals only nine inches for the basin as a whole, it equals 21 inches for the forest area.

About 21 per cent of the basin land is owned by the Federal Government, eight percent by State and local governments, 24 per cent is in Indian Reservation, and 47 per cent is privately owned. National forests occupy most of the Federal land.

RELATED STUDIES BY OTHER AGENCIES

No specific references to sedimentation have been found in reports of other agencies. However, the Corps of Engineers (1) repeatedly mention bank and channel erosion and deposition in connection with flood occurrences and protective measures. Washington reports (2) (3) note from sampling that turbidity ranges from 2 to 66 units, and total dissolved solids from 26 to 358 p.p.m. This was summer season work, with the streams at moderate to low levels. What part of the observed turbidity and solids is due to sediment load is unknown.

SURVEY METHODS

As was done in the Umpqua and Willamette Basins, visual inspection was made of the major stream channels and as much of the watershed

1/ U.S.G.S. records for Kiona gage and Corps of Engineers report.

area as could be conveniently reached by road. Channel conditions with respect to bankcutting, floatable debris, and sediment deposits were noted. Four reservoirs, drawn down at the end of the irrigation season, were visited to ascertain the amount of sediment accumulation in the inflow channels. Logged areas, burned areas, and grazed areas were inspected on different geology and topography to estimate relative sediment contributions. Both dry-farmed and irrigated pasture and cropland were also inspected. Effects of construction of an extensive system of mountain roads for the timber harvest were noted.

Ratings of sediment production were made in five classes. These classes can be broadly interpreted in terms of p.p.m. suspended sediment in average annual total water yield as follows:

Rating Class	Average Suspended Load in p.p.m.
Slight	Under 50
Low	50 to 150
Moderate	150 to 500
High	500 to 1500
Very High	1500 Plus

Estimated ratings are subjective, based on comparing physical conditions of the Yakima with those of basins previously surveyed. No data were available to support the estimates.

However, at the same time that the rating survey was going on, a series of samples were taken along the Yakima River from Easton to Prosser. These samples showed a range from 20 to 451 p.p.m. total solids, and from 1 to 173 p.p.m. suspended solids. This was a sampling of low flow in September; the higher values are mainly those in irrigation return flows. Average suspended load in 24 samples was 20 p.p.m. How much of this is inorganic sediment was not determined.

SURVEY FINDINGS

In the mountainous parts of the basin, the higher ridges are bare and subject to frequent avalanches. These areas are rated "high". Forested slopes covered with the dense mixed conifer types are rated "low"; though grazed areas in the open ponderosa pine type may occasionally be rated as moderate sediment producers. Most of the headwater stream channels carried heavy debris loads and were rated "high" or "very high". Wenas Reservoir and Lake Cle Elum showed considerable sediment accumulation. Major tributary and main river channels were rated "low" to "moderate"; Swauk Creek, however, was rated "high" because of the effects of the dredge mining along several miles of its course. The hills of the central and lower parts of the basin covered only with sparse sagebrush and grass,

varied considerably in their ratings from "low" to "high". Heavily grazed scab ridges at middle elevations were rated "high". Clean-tilled hill croplands were rated "high", but most of the flat valley croplands were rated "slight" or "low".

The overall rating for the basin is "moderate". One percent of the basin area--scab ridges and areas of active channel cutting--was rated "very high"; 25 percent was rated 'high", 32 percent was rated "moderate"; and 42 percent was rated "low". Except for Satus Creek, for the most part rated "high", it would be difficult to establish ratings for individual tributaries. The rating pattern cuts across watershed boundaries indiscriminately, being related more to cover type and elevation and geology and land use.

DISCUSSION

While the appearance of many of the sparsely covered brush and grasslands in the lower hills indicated high erosion losses, with gullied draws and recent delta deposits below, it is doubtful that much sediment moves across the cultivated valley flats to reach stream channels. In the mountain areas, reservoirs block passage of sediments from other areas of high loss. During floods, there is considerable sediment movement, bankcutting and reworking and redeposition of channel materials; this, however, is of infrequent occurrence. In the dry northeastern side of the basin, it is doubtful if the channels--actively cutting and sediment laden though they are--of the numerous minor tributaries carry flows through to the main river very often. They are dry most of the year.

More of the scab ridge areas which have long been subjected to heavy grazing, compaction, and erosion, would be rated "very high" as sediment contributors except that they have already lost most of their soil and now have an "erosion pavement" or "stone mulch" on the surface. Though the rate of soil loss has diminished, runoff rates are very high from these areas.

Because of the extensive diversion of waters of the basin for irrigation of the valleys and terraces, irrigation return flows carry more sediment than the main river much of the year. The amount, however, does not appear excessive, though it significantly affects water quality and stream habitat for fish.

RECOMMENDATIONS FOR IMPROVEMENT

More care to avoid excessive soil disturbance in building roads in the mountains, stabilization of the Swauk Creek dredge mining spoil piles,

rehabilitation of scab ridge grazing lands, less intensive grazing use and better protection from fire on the lower brush and grasslands, cultivation on contour for sloping lands, wider use of soil-binding cover crops, and more efficient irrigation application all would help reduce the sediment yield of the basin.

W. E. Bullard
19 October 1961

BIBLIOGRAPHY

(1) "Report on Yakima River and Tributaries, Washington", Corps of Engineers, U. S. Army, September, 1956.

(2) "An Investigation of Pollution in the Yakima River Basin", Washington Pollution Control Commission Technical Bulletin No. 9, 1951.

(3) "Research and Investigations on the Quality of Water of the Columbia River and Effects on the Fisheries Resources", R. O. Sylvester, University of Washington, January, 1957.

(4) "Yakima Project, Washington, Supplemental Storage", U. S. Bureau of Reclamation, Region I, May, 1956.